

## **REMARKS**

Claims 1 – 23, 26, 28 – 40, 42 - 48 and 50 – 59 are now pending in the application. The Examiner is respectfully requested to reconsider and withdraw the rejection(s) in view of the amendments and remarks contained herein.

### **REJECTION UNDER 35 U.S.C. § 103**

Claims 1 – 23, 26, 28 – 48 and 50 – 57 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over DE 3324483 in view of Zick et al. (U.S. Pat. No. 6,236,177), Konda et al. (U.S. Pat. No. 6,232,758), DE3636555 (translation enclosed herewith), and Gilpin et al. (U.S. Pat. No. 5,598,082). Applicants respectfully traverse this rejection.

Applicants' invention in one aspect is directed to a motor braking circuit having a braking power switching device connected across motor windings of a motor that is repeatedly cycled to intermittently short the windings to brake the motor. The braking power switching device may be a semiconductor having an internal diode that acts as a free-wheeling diode across the windings of the motor and is used instead of a separate free-wheeling diode. In another aspect, a controller is coupled to the braking power switching device and is operative to cycle the braking switching device open and closed with a sequence of pulses to intermittently short the windings to brake the motor when the switch is switched off, the controller adjustable to vary at least one of a duty cycle and a frequency of the sequence of pulses. In another aspect, the braking power switching device has a small amount of resistance to reduce peak current flow when the windings are shorted through the braking power switching device. In another aspect, a

power tool has the motor braking circuit. In a further aspect, the power tool has a trigger switch housed in a module that also houses the braking switching device.

Claims 1, 16, 22, 38, 47, 51, 54, 57 and 58 are the independent claims. Turning first to claim 1, applicants have amended claim 1 so that it now recites, *inter alia*, that the braking power switching device has a small amount of resistance to reduce peak current flow when the windings are shorted through the braking power switching device. Applicants submit that none of the references applied by the Examiner disclose intermittently shorting windings of a motor with a braking power switching device that has a small amount of resistance to reduce peak current flow when the windings are shorted through the braking power switching device. At best, they disclose braking a motor by pulsing a power transistor with a variable pulse sequence and/or pulse magnitude. [see, e.g., DE3324483]. Applicants submit that amended claim 1 is thus allowable.

Claims 1 – 15 depend directly or indirectly from amended claim 1 and are allowable for at least that reason.

Further, claim 9 requires that the internal diode of the FET that is used as the braking power switching device be used in lieu of a separate diode across the windings of the motor. The Examiner cited Konda et al. as disclosing a FET with an internal diode and takes the position that it, combined with the other references, renders claim 9 obvious. Konda discloses a drive control circuit 13 having a plurality of FETs 19 – 24 connected in a three-phase bridge. A freewheeling diode is connected between the source and drain of each FET, and may be integral with the FET. [see, e.g., col. 5 lines 8-11]. However, Konda et al. does not disclose a circuit where a separate diode across

the windings of the motor is eliminated, which is a freewheeling diode as discussed in the application [Application, Par. 9], and instead the internal diode of the FET is used as the freewheeling diode. Applicants are not claiming in claim 9 a FET having an internal diode. Rather, Applicants are claiming in claim 9 that the internal diode of the FET be used in lieu of a separate external diode, where the internal diode is used as a path for current to flow into as current leaves out of the motor windings at the bottom of the motor and back into the motor windings at the top of the motor. Applicants submit that Konda et al. does not disclose using the internal diode of its FET in lieu of a separate diode across the windings of the motor as used in the Applicant's braking circuit, and such is not disclosed in the other references. Applicants submit that claim 9 is allowable for also this reason.

Applicants have also amended independent claim 16 so that it now recites, *inter alia*, the internal diode of the FET, that is used as the braking power switching device, be used in lieu of a separate diode across the windings of the motor. Therefore, for the reasons discussed above with respect to claim 9, applicants submit that amended claim 16 is allowable.

Claims 18 – 21 depend directly or indirectly from amended claim 16 and are allowable for at least that reason.

Claim 17 has been canceled.

Independent claim 22 similarly requires that the internal diode of a FET coupled across windings of a motor act as freewheeling diode and be used in lieu of a separate diode. For the reasons discussed above with respect to claim 9, applicants submit that independent claim 22 is allowable.

Claims 23, 26 and 28 – 37 depend directly or indirectly from independent claim 22 and are allowable for at least that reason.

Further, claim 30 requires that a module that houses the trigger switch also house the FET that is coupled across the motor windings. The Examiner has cited Gilpin et al as disclosing “a module with trigger switch.” While Gilpin et al discloses a trigger switch located in a trigger module, it fails to disclose that the module also houses a FET that is coupled across the motor windings that is cycled on and off to brake the motor. Applicants submit that claim 30 is also allowable for this reason.

Independent claim 38 is directed to a power tool. Applicants have amended it so that it now recites, *inter alia*, that the braking switching device has a small amount of resistance to reduce peak current flow when the windings are shorted through the braking switching device. Applicants submit that amended independent claim 38 is allowable for at least the reasons discussed above with respect to amended claim 1.

Claims 39 – 40 and 42 – 46 depend directly or indirectly from amended independent claim 38 and are allowable for at least that reason.

Claim 40 requires that the internal diode of a FET coupled across windings of the motor acts as a freewheeling diode in lieu of a separate freewheeling diode. Applicants submit that for at least for the reasons discussed above with respect to claim 9, claim 40 is allowable.

Claim 42 requires that the module that houses the trigger switch also house the braking switching device. For the same reasons discussed above with respect to claim 30, applicants submit that claim 42 is also allowable.

Claim 41 has been canceled.

Independent claim 47 is directed to a method of braking a motor. Applicants have amended independent claim 47 so that it now recites, *inter alia*, that the braking switching device has a small amount of resistance to reduce peak current flow when the windings are shorted through the braking switching device. For at least the reasons discussed above with respect to amended independent claim 1, Applicants submit that amended independent claim 47 is allowable.

Independent claim 51 is directed to a method of braking a motor in a cordless power tool. Applicants have amended independent claim 51, so that it now recites, *inter alia*, that the semiconductor switch that is switched on and off to intermittently short them motor windings to brake the motor has a small amount of resistance to reduce peak current flow when the windings are shorted through the semiconductor switch. Applicants have similarly amended independent claim 54, which is directed to a method of braking a motor in a mains powered power tool. For the reasons discussed above with respect to amended independent claim 1, Applicants submit that amended independent claims 51 and 54 are allowable.

Claims 52 and 53 depend directly or indirectly from amended independent claim 52 and are allowable for at least that reason.

Claims 55 and 56 depend directly or indirectly from amended independent claim 54 and are allowable for at least that reason.

Further, claim 53 requires that the internal diode of the MOSFET that is used as the semiconductor switch be used as a freewheeling diode in lieu of a separate diode.

Applicants submit that amended claim 53 is thus also allowable for at least the reasons discussed above with respect to claim 9.

Independent claim 57 is directed to a power tool. It recites, *inter alia*, that an internal diode of the FET that is coupled across the motor windings and cycled open and closed to brake the motor act as a freewheeling diode and be used in lieu of a separate freewheeling diode. For the reasons discussed above with respect to claim 9, applicants submit that independent claim 57 is allowable.

New claim 58 is directed to a power tool. It recites, *inter alia*, that an internal diode of a FET that is coupled across motor windings that is cycled open and closed to intermittently short the windings to brake the motor act as a freewheeling diode and is used in lieu of a separate freewheeling diode. It also recites that the FET has a small amount of resistance to reduce peak current flow when the windings are shorted through the FET. For the reasons discussed above with respect to independent claims 1 and 16, applicants submit that new claim 58 is allowable.

New claim 59 depends from claim 58 and is allowable for at least that reason.

## CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

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